ADF&G, Cold Water RAS Hatchery Construction and Operation

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Challenges To Hatchery Program

- Limited water supplies
- Inability to isolate production
- Inability to exclude predators
- Crumbling raceways and pipelines
- Failure of $2 million Treatment Sys.

  (Designed by Montgomery Watson)

- Loss of free heat to hatcheries beginning in 2003 ($4,000,000 unrealized utility cost)
- Inability to produce catchable sized Trout, Chinook and Grayling
- 30% - 50 % loss in productivity

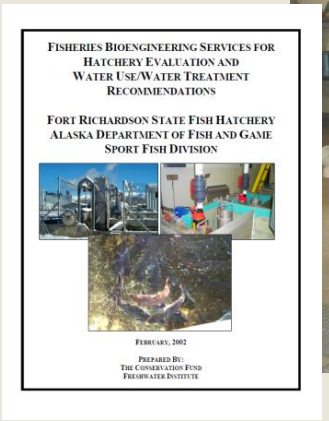
Hatchery Sites

Immediate Response to Challenges

- Isolated Rearing Systems
- Redeveloped and Reclaimed Wells (2,000 - 3,000 gpm) a “Jack” thing
- Investigated Alternative Water Conservation Strategies
- Sent Staff to Recirculating Aquaculture Training Courses
- Constructed and Operated Pilot RAS for Evaluation
- Entire Facility running at 50% to 75% Reuse.

Why Consider RAS Facilities

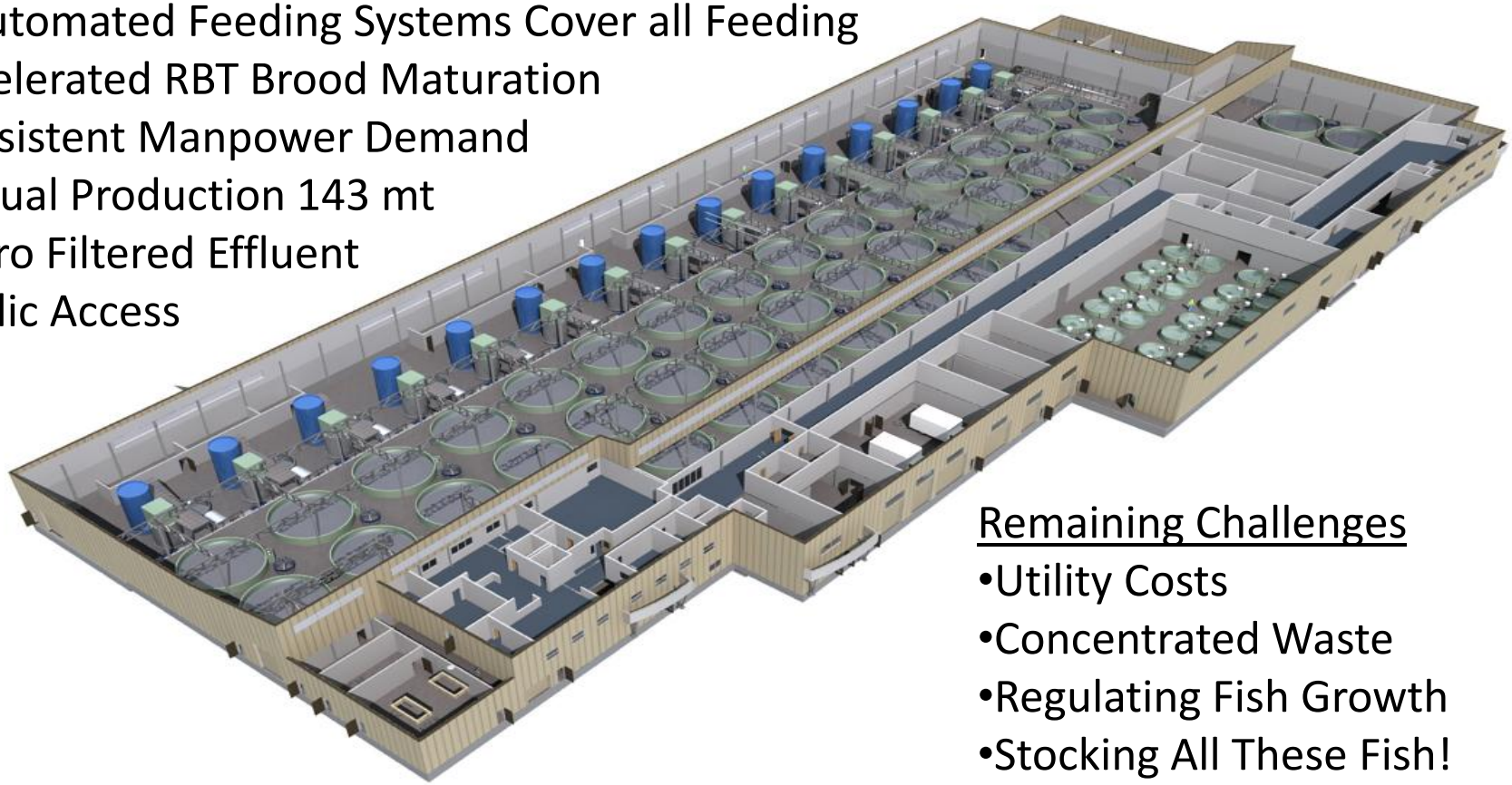
- Freshwater Institute, Harry Westers and PR Aqua
- Toured Many, Many, Many, Hatcheries (Public and Private)
- Secure Environment for Staff and Fish
- Control Water Quality and Isolate Production
- Future Program Demands
- Lack of Alternatives
- Staff Commitment



WJHSFH

Benefits

- 42 Isolated Systems
- 15 full RAS Systems
- Completely Enclosed
- Up to 98% Recirculation
- Redundant Well Water Supply
- 4 Automated Feeding Systems Cover all Feeding
- Accelerated RBT Brood Maturation
- Consistent Manpower Demand
- Annual Production 143 mt
- Micro Filtered Effluent
- Public Access



Remaining Challenges

- Utility Costs
- Concentrated Waste
- Regulating Fish Growth
- Stocking All These Fish!

RBSFH - Fairbanks

Benefits

- 18 Isolated Systems
- 5 RAS Systems
- Up to 98% Recirculation
- Automated Feeding System
- Completely Enclosed
- Micro Filtered Effluent to Sewer
- Visitor Area
- Annual Production 45 mt

Remaining Challenges

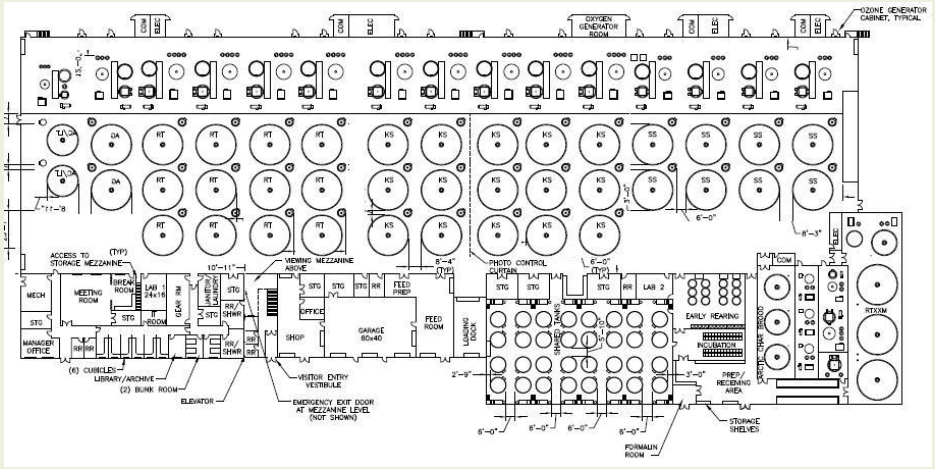
- Utility Costs ($0.23/KWH)
- Maintaining Influent Treatment 0.9^{o} C, Fe 7 mg/l, Mn 0.7 mg/l

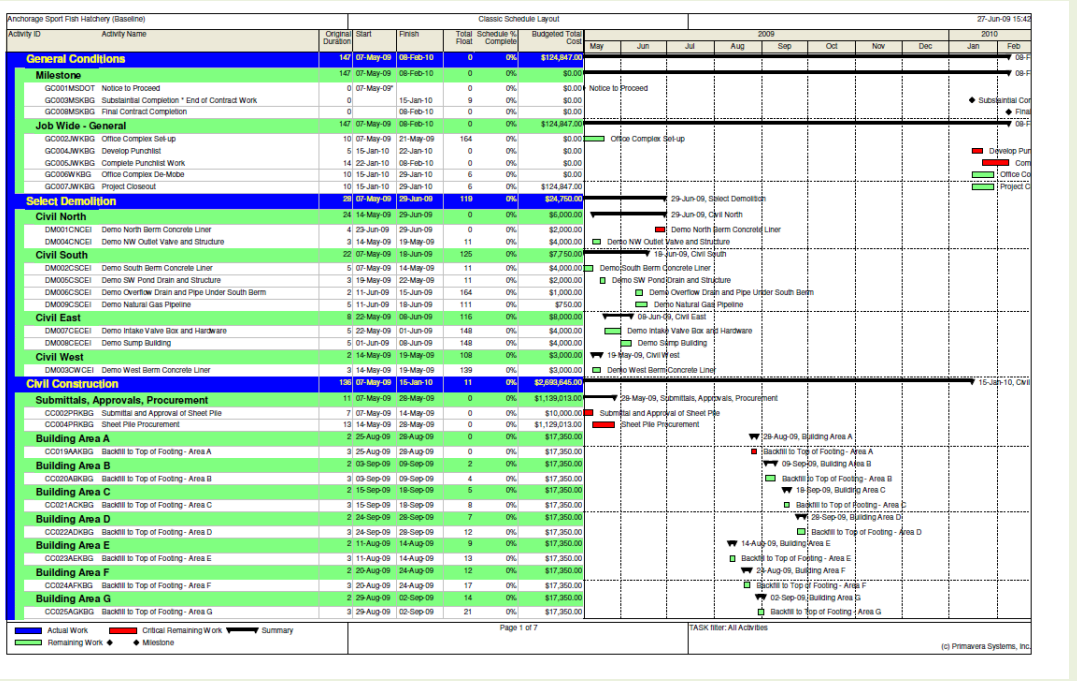
Project Obstacles (Large Projects)

- Politics
- Funding
- Bureaucracy
- Determining Need
- Large Consulting Firms
- Establishing Production Goals and Facility Scope
- Establishing Responsibility and Accountability

Design Management (Large Projects)

- Bureaucracy/Org.
- Establishing Process
- A & E Firms
- Communication
- Geography
- Staff Participation
- Decision Making
- Design Review
- Value Engineering





Construction (3 years)

- Project Management
  - A&E Firm
  - Contractor
  - Owner
- Contingency
- Problem Solving
- Cost Reductions
- Additive Alternates
- Cost Management

Startup and Operation

- Planning and Tracking
- Limited Loading
- Problem Solving
- Responsibility and Accountability
- Costs
- Staffing
- Training
- Stress

Label			LT		RBT					RBTXXM			SS BL		SS JC		SS SC	
Life Stage			Subcatchable	Catchable	Fingerling	Subcatchable	Catchable	Brood 1.5-2	Brood 2-3	Fingerling	Catchable	Brood	Fingerling	Smolt	Fingerling	Smolt	Fingerling	Smolt
Date	start		7-Feb-09	10-Jul-09	25-Mar-08	1-Jul-08	29-Aug-08	15-May-09	30-Jan-10	25-Mar-08	20-Aug-08	30-Jan-09	1-Feb-08	1-Jul-08	1-Feb-08	1-Jul-08	1-Feb-08	1-Jul-08
	first release		10-Jul-09	15-May-10	15-Jun-08	29-Aug-08	15-May-09	30-Jan-10	30-Jan-11	20-Aug-08	30-Jan-09	30-Jan-10	15-May-08	15-May-09	15-May-08	15-May-09	15-May-08	15-May-09
	last release		10-Jul-09	15-Jun-10	1-Jul-08	29-Aug-08	15-Aug-09	30-Jan-10	30-Jan-11	20-Aug-08	30-Jan-09	30-Jan-10	1-Jul-08	1-Jul-09	1-Jul-08	1-Jul-09	1-Jul-08	1-Jul-09
Duration	min	days	153	309	82	59	259	260	366	148	163	365	104	318	104	318	104	318
	max	days	153	340	98	59	351	260	366	148	163	365	151	365	151	365	151	365
Unit weight	start	g	0.16	10.00	0.14	2.00	7.30	120.00	400.00	0.14	7.00	57.00	0.20	3.00	0.20	3.00	0.20	3.00
	end	g	10.00	160.00	2.00	7.30	120.00	400.00	1000.00	7.00	57.00	400.00	3.00	23.00	3.00	23.00	3.00	23.00
Weight increase		g	9.84	150.00	1.86	5.30	112.70	280.00	600.00	6.86	50.00	343.00	2.80	20.00	2.80	20.00	2.80	20.00
Condition factor (k) as W/L^3		g/cm3	0.0125	0.0125	0.0110	0.0120	0.0120	0.0120	0.0120	0.0110	0.0120	0.0120	0.0090	0.0110	0.0090	0.0110	0.0090	0.0110
Length	start	cm	2.3	9.3	2.3	5.5	8.5	21.5	32.2	2.3	8.4	16.8	2.8	6.5	2.8	6.5	2.8	6.5
	end	cm	9.3	23.4	5.7	8.5	21.5	32.2	43.7	8.6	16.8	32.2	6.9	12.8	6.9	12.8	6.9	12.8
Length increase		cm	7.0	14.1	3.3	3.0	13.1	10.6	11.5	6.3	8.5	15.4	4.1	6.3	4.1	6.3	4.1	6.3
Daily length gain		cm	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temperature unit growth rate (TUG)		cm/deg C	0.0055	0.0055	0.0037	0.0045	0.0045	0.0045	0.0045	0.0037	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045
Temperature		deg C	**8.3**	**8.3**	**11.0**	**11.2**	**11.2**	**9.1**	**7.0**	**11.4**	**11.5**	**9.4**	**8.8**	**4.4**	**8.8**	**4.4**	**8.8**	**4.4**
Survival assumption			98%	96%	66%	100%	96%	95%	95%	66%	96%	95%	99%	99%	95%	99%	99%	99%
Number of fish	start		44,882	43,984	1,739,067	338,284	338,284	4,853	4,367	4,491	2,964	2,696	671,564	484,848	127,592	121,212	939,979	787,879
	end		43,984	42,225	1,147,784	338,284	324,753	4,610	4,149	2,964	2,845	2,561	664,848	480,000	121,212	120,000	930,579	780,000
	released		0	42,225	809,500	0	319,900	243	4,149	0	150	2,561	180,000	480,000	0	120,000	142,700	780,000
	on-grow		43,984	0	338,284	338,284	4,853	4,367	0	2,964	2,696	0	484,848	0	121,212	0	787,879	0
Biomass	start	kg	7	440	243	677	2,469	582	1,747	1	21	154	134	1,455	26	364	188	2,364
	end	kg	440	6,756	2,296	2,469	38,970	1,844	4,149	21	162	1,024	1,995	11,040	364	2,760	2,792	17,940
	released	kg	0	6,756	1,619	0	38,388	97	4,149	0	9	1,024	540	11,040	0	2,760	428	17,940
Maximum allowable density		kg/m^3	80	80	35	35	35	30	30	45	45	45	46	60	46	60	46	60
Total volume of tanks required		m^3	5	84	66	71	1113	61	138	0	4	23	43	184	8	46	61	299
Volume per tank		m^3	1.4	40.1	8.2	8.2	91.7	91.7	91.7	0.16	8.2	25.6	8.2	91.7	8.2	91.7	8.2	91.7
# of tanks required		tanks	4	3	8	9	13	1	2	3	1	1	6	3	1	1	8	4
# of tanks used		tanks	**4**	**2**	**10**		**12**	**1**	**2**	**3**	**1**	**1**	**6**	**2**	**4**	**2**	**8**	**4**
Actual tank volume		m^3	5.6	80.2	82	82	1100.4	91.7	183.4	0.48	8.2	25.6	49.2	183.4	32.8	183.4	65.6	366.8
Actual max density		kg/m^3	**78.5**	**84.2**	**28.0**	**30.1**	**35.4**	**20.1**	**22.6**	**43.2**	**19.8**	**40.0**	**40.5**	**60.2**	**11.1**	**15.0**	**42.6**	**48.9**

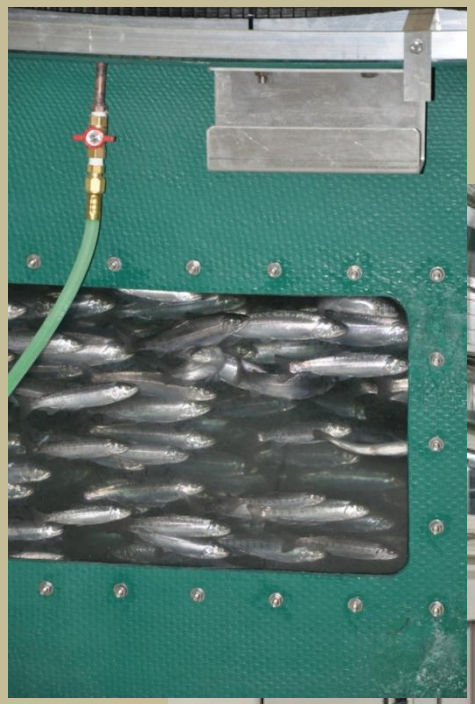
Oooops!!!!

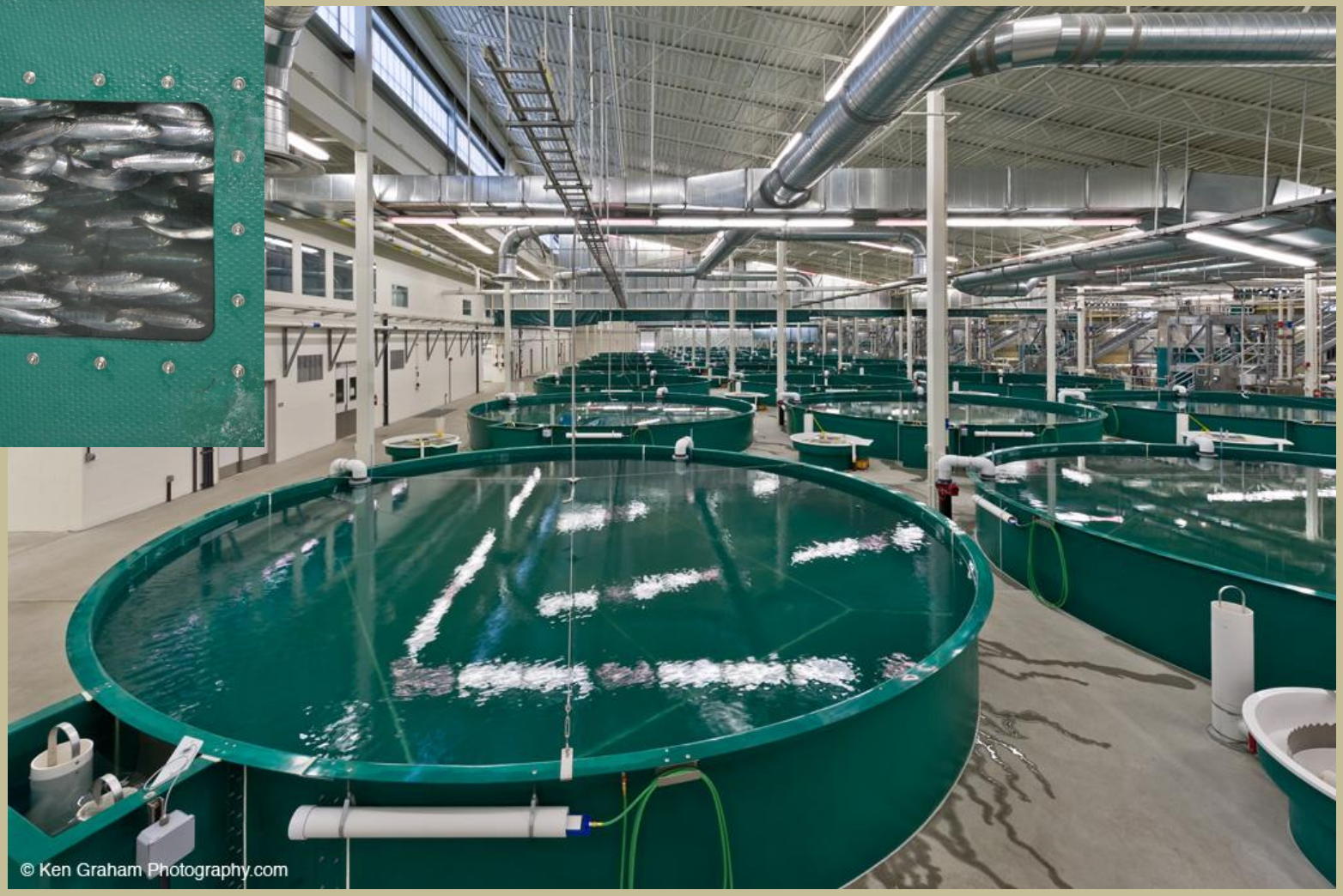
Recycle Systems

-Radial Flow Settlers
-Micro Screen Drum Filters
-Pump Sump
-Reuse Pumps
-Fluidized Sand Bio-Filter
-CO2 Stripper
-O2 and O3 Injection
-UV
-Operating Temp 4 – 13^{o} C

WJHSFH - 15 Recycle Systems in Primary Production Area

Main Production Floor





Feed Systems

Overhead Feed Delivery and Spreaders

Top View (Public Access Highlighted)

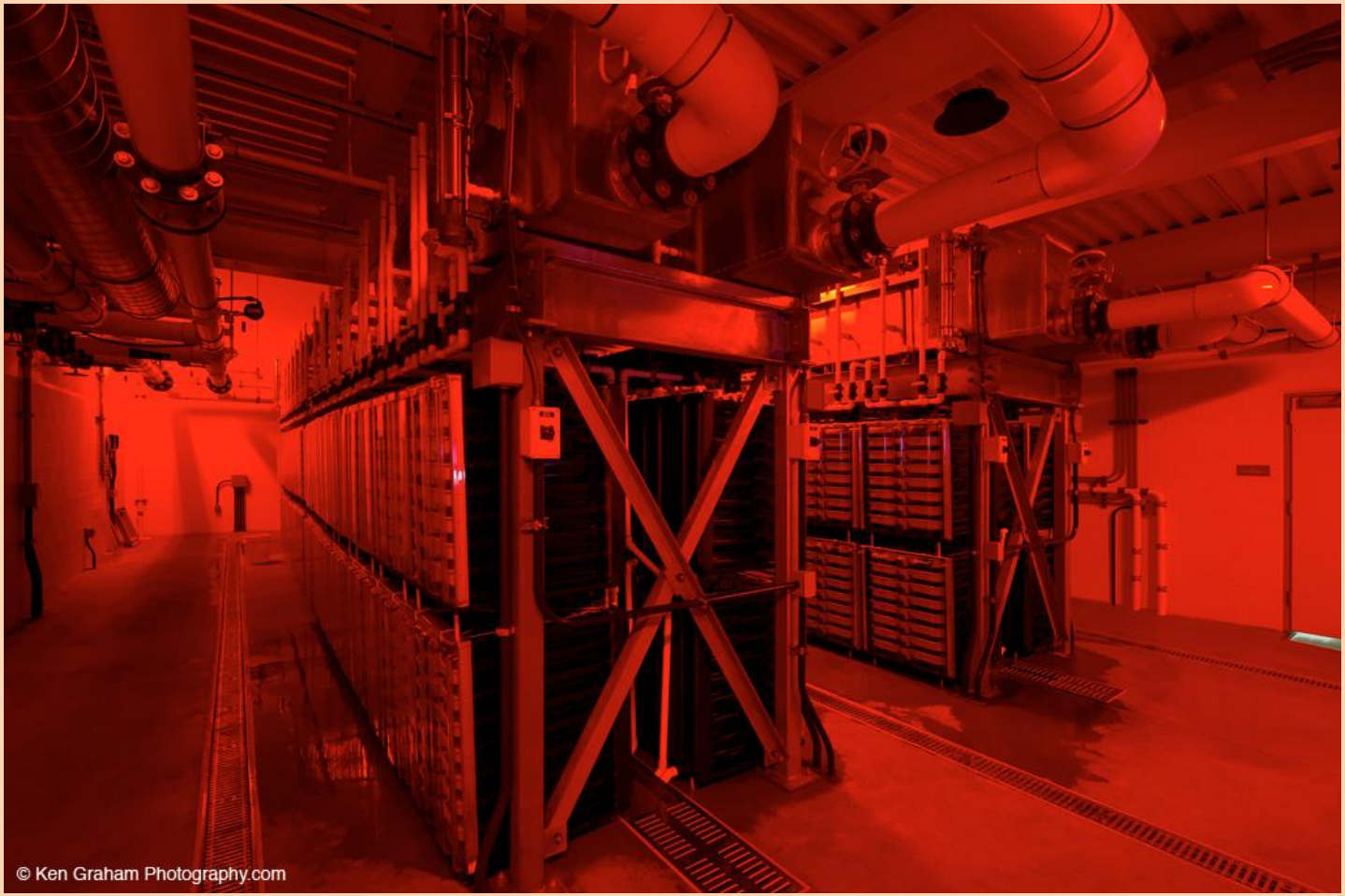
Visitor's Corridor

BY 2011 Rainbow Trout, Sept. 2011

BY 2011 March 2012

BY2011 Chinook, March 2012

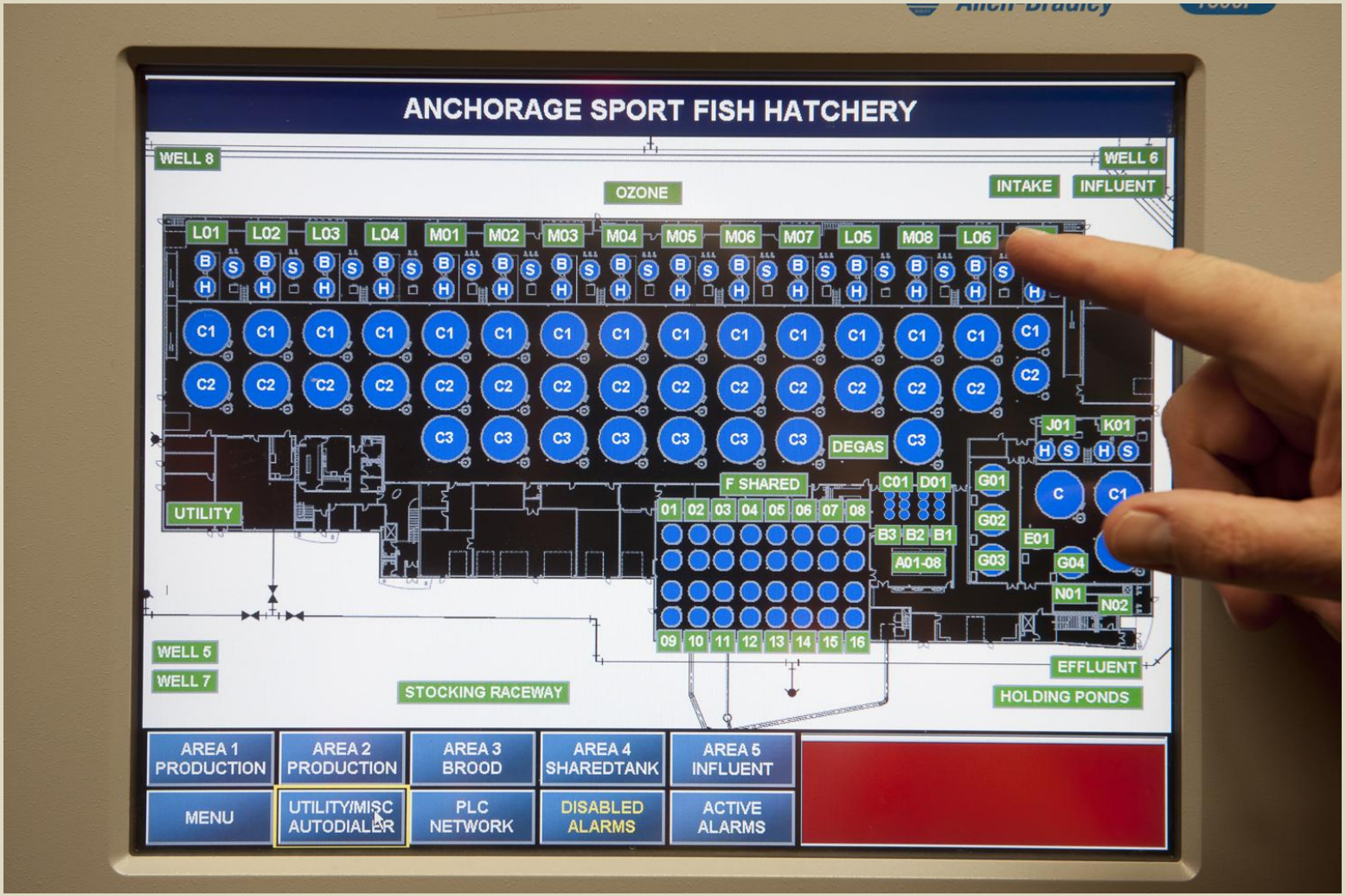
Incubation Room



Early Rearing for Broodstock and Grayling

Startup Rearing (Partial Reuse)

SCADA HMI Screen



Oxygen Sieve/Concentrators

Process Water and Building Heat Exchangers

Boilers

Backup Generators

Main Entry Area

Hatchery Exterior

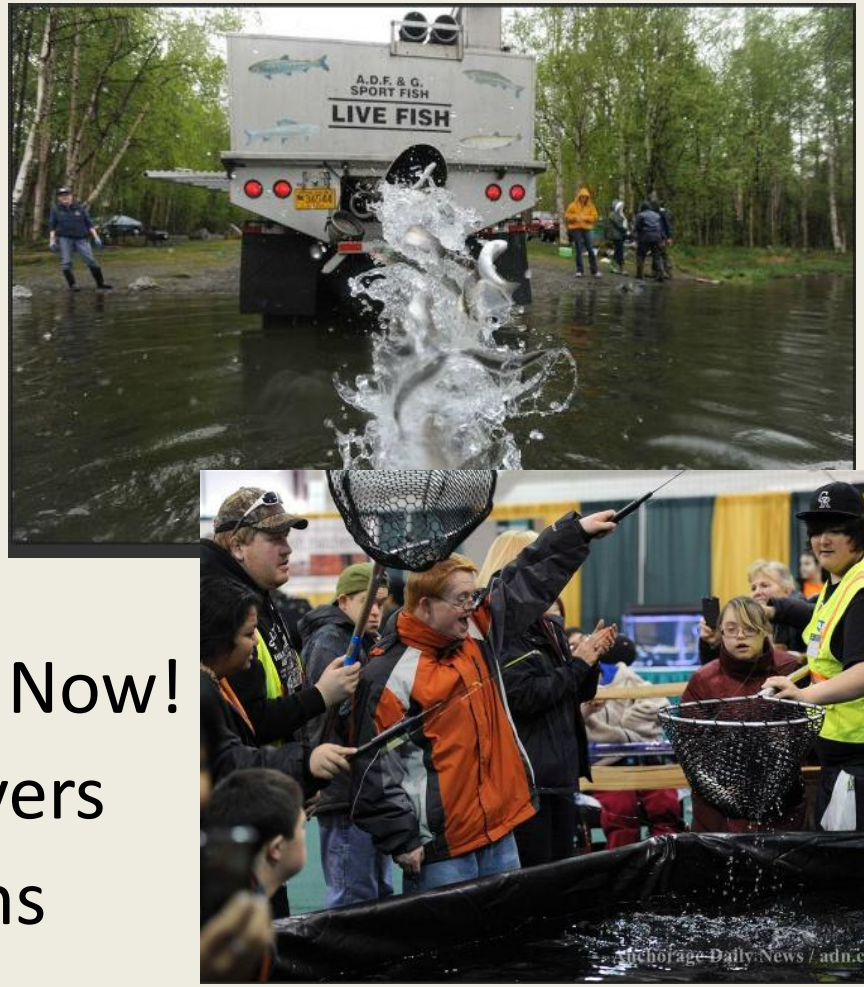
Over View of Facility (250’x600’)

Outcomes

- RAS Work!
- Primary Goals Met
- Small Things Missed
- Steep Learning Curve for Staff
- Building Systems Management Critical
- Optimization Problematic
- Concentrated Effluent Disposal Still Challenging
- Some Staff Near Burnout (recovering quickly)

Recommendations

- Be Proactive
- Eliminate the word “NO”
- Always Include Staff
- Learn From Others
- Establish Clear Goals
- Establish Clear Process
- Start With a Pilot System Now!
- Minimize Third Party Players
- Focus on Solving Problems
  (Keep it from getting personal)
- Hold People Accountable (Design Build)



Was It Worth It?

Heck Yes!!!!

Thank You

- Harmannus “Harry” Westers

  Beware of Dogmatic Statement such as, *Chinook cannot exceed a rearing density of 32 kg/m3*. Such declarations must be challenged….New ideas should constantly generate creative and innovative responses to operational and design practices (challenges).”

- Steve Summerfelt and Brian Vinci ***Freshwater Institute***

- Wayne Gorry and KC Hosler

- ADF&G Hatchery Staff

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